~~Description~~

Toothbrush

BACKGROUND OF THE INVENTION

Technical Field

The invention relates to a toothbrush with a toothbrush head supported by a toothbrush body according to the preamble of claim 1.

Description of Related Art

Many types of eccentrically driven toothbrushes with different designs are commercially available.

Such toothbrushes typically have a toothbrush head that is supported by a toothbrush body and interchangeably attached to an electrical hand tool. The toothbrush head has a bristle carrier which receives the bristles and is pivotally supported for pivoting about a pivot axis. The toothbrush head can be reversibly pivotally driven by an eccentric drive and pivots alternatingly in two pivot directions with a specified pivot angle of, for example, 130 degrees.

In a commercially available and widely used toothbrush, the eccentric motion is produced by an eccentric gear arranged after the drive motor. The eccentric gear produces a reversing stroke motion which is transferred to a drive pin. The drive pin penetrates the toothbrush body, wherein the angled end of the drive pin which extends in the axial direction with respect to the pivot axis of the bristle carrier, engages in a corresponding bore located on the bristle carrier. The drive-pin bore is here radially offset from the pivot axis. In this way, the reversing stroke action of the lifting rod is transformed into a reversing pivot motion of the bristle body. Such eccentric drives for toothbrushes are described, for example, in the publications U.S. 5,617,601 or U.S. 5,524,312.

Another variation of an eccentric drive for toothbrushes is described in WO 96/37 164. In this variation, the circular rotary motion of the drive motor is transmitted directly to a drive shaft which penetrates the toothbrush body and has an angled end. The angled end engages with a corresponding guide channel located on the bristle carrier, thereby inducing a reversing pivot motion in the bristle carrier. This arrangement produces a mechanically very simple and wear-resistant drive. This type of drive also requires very little space, so that the housing can have a slim and compact form.

Although a reversibly driven toothbrush of this type operates reliably, it does have several disadvantages. In particular, the tooth cleaning ability of such a toothbrush still needs to be improved.

It is also known to improve the tooth cleaning ability by superimposing an additional motion on the

rotation motion. For example, W0 96/31171 or DE 44 33 914 A1 describe toothbrushes of this type with an eccentric drive, wherein the bristle carrier executes a sort of pivoting motion.

It has been demonstrated, however, that such toothbrush is still unable to clean teeth optimally. Moreover, the toothbrush is mechanically complex.

Summary of the Invention

Accordingly, the invention addresses the problem of improving a toothbrush of the aforedescribed type in such a way that it has an improved cleaning ability as well as a simple construction.

The stated problem is solved with a toothbrush of the aforedescribed type by the characterizing features of claim 1.

Advantageous embodiments of the invention are described in the characterizing features of the dependent claims.

The invention relies on the concept of supporting the bristle carrier for axial displacement on the toothbrush head and to drive the bristle carrier with the eccentric drive reversibly backward and forward along a linear path. This impresses on the bristle carrier an oscillating axial displacement motion which results in an excellent tooth cleaning ability.

According to a first embodiment, the toothbrush head has at least one bearing channel adapted to engage with at least one corresponding bearing projection. This embodiment employs limit stops that limit the linear travel path of the backward and forward motion (stroke) of the bristle carrier.

According to a second embodiment, the axial linear travel can be directly impressed on the bristle carrier. For this purpose, a sliding block can be affixed in the axial direction in the guide channel of the bristle carrier; alternatively, the sliding block can be moveable in the axial direction between limit stops. The sliding block also has a drive-pin bore or a guide channel, with the eccentric pin engaging in the guide channel. The bristle carrier is supported on the toothbrush head for axial displacement so as to positively follow the corresponding motion of the eccentric pin in the axial direction between the two reversing points. Accordingly, as described above, an axial displacement motion is superimposed on the rotation motion.

According to additional embodiments, the superimposed axial displacement motion can also be produced by providing the bristle carrier with at least one drive-pin channel which is disposed along a circumferential segment of the bristle carrier and inclined in the axial direction. The

toothbrush head has a corresponding drive pin adapted to engage with the drive-pin channel. A rotary motion is thereby positively transmitted to the bristle body to produce an axial displacement motion, since the drive-pin channel has an axial component. This arrangement provides an additional simple mechanical link guide proximate to the circumference of the bristle carrier. It is sufficient to provide a single drive pin and correspondingly a single drive-pin channel, wherein the arrangement of drive pin and drive-pin channel can be interchanged.

Alternatively, two diametrically opposed drive pins can be arranged on the toothbrush head. This arrangement reduces the stress on the drive pins and on the channel, since now two link guides produce the axial force.

According to a fifth embodiment, the guide channel can be formed directly in the bristle carrier. The eccentric pin directly engages the guide channel and thereby moves backwards and forwards between a front and a rear reversing point. A force can thereby be transmitted via the sides of the guide channel extending in the axial direction, thereby reversibly driving the bristle carrier.

This embodiment operates very quiet due to the small number of moveable parts and is suited in particular for high-frequency applications, i.e., so-called fast-running toothbrushes which are commonly referred to as "ultrasonic" toothbrushes. The eccentric shaft of such toothbrushes rotates with the rotation speed in the range between 15,000 and 25,000 revolutions per minute. At such high rotation speeds, the components are subjected to particularly high stress which is amplified by the continuous reversal of the rotation direction of the toothbrush body. It is therefore important to construct the toothbrush in the simplest possible fashion, as implemented to a great extent by the aforedescribed measures.

The proposed construction does not require additional constructive measures to impress on the bristle carrier the axial displacement motion in addition to the oscillatory pivoting motion. This combination results in the excellent tooth cleaning ability mentioned above. For this purpose, the length of the guide channel in the axial direction is smaller than the travel path between the front and the rear reversing points of the eccentric pin.

The travel of the eccentric pin is bounded by the limited length of the guide channel in the axial direction. The bristle carrier is supported for axial displacement on the toothbrush head so as to positively execute in the axial direction the corresponding motion of the eccentric pin between the two reversing points. This causes an axial displacement motion to be superimposed on the rotation motion.

According to a sixth embodiment, a sliding block is affixed in the axial direction on the bristle carrier. The sliding block has a guide channel adapted to engage with the eccentric pin which can move backward and forward in the axial direction between a front and a rear reversing point.

According to a seventh embodiment, the sliding block is supported in the guide channel for axial displacement. The sliding block has a drive-pin bore adapted to engage with the eccentric pin. The eccentric pin thereby guides the sliding block backward and forward between a front and a rear reversing points inside the guide channel integrated in the bristle carrier.

All embodiments with a sliding block have in common that the sliding block and the corresponding recess or guide channel, respectively, disposed on the bristle carrier are formed so as to enable a rotation or pivoting motion of the sliding block which opposes the pivot motion of the bristle body, so that the eccentric pin engaging with the recess or guide channel is not subjected to bending stress.

The sliding blocks typically have a cylindrical shape, thereby providing a reliable support in the recess and guide channel, respectively. According to a preferred embodiment, the sliding block can also have a spherical shape. This embodiment advantageously minimizes the friction forces produced between the sliding block and the recess or the guide channel, respectively.

Brief Description of the Drawings

The invention will now be described in more detail with reference to the embodiments illustrated in the drawings. It is shown in:

Fig. 1 a cross-sectional view of a drive according to a first embodiment;

Fig. 2 an enlarged cross-sectional view (detail) of a drive according to Fig. 1;

Fig. 3 an enlarged cross-sectional view of a drive according to a second embodiment;

Fig. 4 an enlarged cross-sectional view of a drive according to a third embodiment;

Fig. 5 an enlarged cross-sectional view of a drive according to a fourth embodiment; and

Fig. 6 an enlarged cross-sectional view of a drive according to a fifth embodiment.

The first embodiment of a toothbrush 1 is depicted in Fig. 1.

Detailed Description of Various Embodiments

A toothbrush head 12 forms a component of a toothbrush body 10 which can be interchangeably connected to a handle portion 60. A bearing journal 16 which engages with a corresponding bearing bore 26 of a bristle carrier 20 is disposed on the toothbrush head 12. The bearing journal 16 therefore represents the rotary/pivot bearing for the bristle carrier 20.

The toothbrush head 12 also includes a circumferential bearing channel 14 adapted to engage with a corresponding bearing projection 24 of the bristle carrier 20. As a result, the axial travel path of the bristle carrier 20 with respect to the toothbrush head 12 is limited, which prevents the bristle carrier 20 from becoming detached. The bristle carrier 20 includes a recess 28 extending in the axial direction, with a sliding block 30 having a guide channel 32 being inserted in the recess 28. The axial position of the sliding block 30 is defined with respect to the recess 28 and the bristle carrier 20, respectively.

An eccentric pin 52 of a drive shaft 50 engages in the guide channel 32, which in the given example is in form of a bore. However, the guide channel 32 can also extend in the axial direction. The drive shaft 50 is rotatably driven by a motor 40.

Accordingly, the bristle carrier 20 moves in the following fashion:

As seen more particularly from the enlarged diagram X of Fig. 1, the eccentric pin 52 in the exemplary cross-sectional view is located at the left reversing point. When the rotation starts, the position of the eccentric pin 52 moves to the right, until the eccentric pin 52 reaches a right reversing point.
The toothbrush head 20 thereby executes the pivoting motion indicated in the top right corner of the partial view, namely starting from the left end position indicated by the solid line to the right end position indicated by the dashed line. When the pivoting motion continues, the eccentric pin 52 returns to its initial position, with the toothbrush body 20 executing a pivoting motion in the opposite direction.

The motion can only be performed reliably if the eccentric pin 52 is laterally guided with a relatively small clearance, so that the pivotal motion can be transformed substantially without play. In addition, the sliding block 30 has to be supported in the recess 28 so as to be able to pivot about its longitudinal axis in the opposite direction of the rotation of the bristle carrier 20 to compensate for the motion of the bristle carrier 20, in order to prevent bending stress on the engaging eccentric pin 52. The sliding block 30 and the recess 28 have a matching circular cross-section to enable an essentially play-free compensating motion without noticeable friction. It should also be noted that the length of the eccentric pin 52 is selected so that it always

engages the sliding block 30 regardless of the actual position of the sliding block 30.

With this simple mechanical arrangement, the continuous rotary motion of the drive shaft 50 can be transformed into a reversing rotary motion (pivoting motion).

Fig. 2 is an enlarged view of the toothbrush according to Fig. 1. The following detailed features can be seen in Fig. 2:

An upper end of a toothbrush body 210 has a toothbrush head 212 with a bearing journal 216. The bearing journal 216 receives a bristle carrier 220 on a bearing bore 226.

The bristle carrier 220 is supported for axial displacement relative to the toothbrush head 212. A circumferential bearing projection 224 engages with a bearing channel 214 on the toothbrush head 212, wherein the bearing channel 214 is constructed so that the bristle carrier 220 can travel between a forward axial position, shown in Fig. 2 on the left, and a rearward axial position, shown in Fig. 2 on the right. The maximum travel path is referred to as "stroke."

The bristle carrier 220 includes an axial guide channel 228 in which a sliding block 230 is inserted. The sliding block 230 is fixed in the axial direction relative to the bristle carrier 220. In addition, the sliding block 230 has a drive-pin bore 232 adapted to engage with an eccentric pin 52 of a drive shaft 50.

Since the eccentric pin 52 is positively coupled with the bristle carrier 220 in the axial direction via the sliding block 230, the bristle carrier 220 executes an axial linear motion which is superimposed on the rotation motion. This high-frequency pulsating motion in the axial direction significantly improves the cleaning result. This observation can therefore be implemented by simple mechanical means, as discussed with reference to the aforedescribed embodiment.

Fig. 3 shows a toothbrush 300 in which an axial linear motion of a bristle carrier 320 is also implemented by a positive coupling.

Again, a toothbrush body 310 with a toothbrush head 312 and a bearing journal 316 is provided. The bearing journal 316 receives the bristle carrier 320 for axial displacement in a bearing bore 326.

The bristle carrier 320 includes an axial guide channel 328 in which an axially moveable sliding block 330 is inserted. The sliding block 330 has a drive-pin bore 332 adapted to engage with an

eccentric pin 52 of a drive shaft 50.

In addition, two diametrically opposed, radially inwardly-facing drive pins 314 are inserted on the toothbrush head 312. The drive pins 314 engage with two corresponding drive channels 324 disposed along a circumferential segment of the bristle carrier 320. The drive pins 314 are slightly inclined in the axial direction, so that a rotation motion of the bristle carrier 320 causes a positively coupled axial displacement motion.

The toothbrush 400 depicted in Fig. 4 is implemented essentially identical to the aforedescribed embodiments.

Again, a toothbrush body 410 has a toothbrush head 412 with a bearing journal 416. The bristle carrier 420 is supported for longitudinal displacement on the bearing journal 416 by a bearing bore 426.

The bristle carrier 420 has an axial guide channel 428 in which a sliding block 430 is supported for axial displacement. The sliding block 430 has a drive-pin bore 432 adapted to engage with an eccentric pin 52 of a drive shaft 50.

So far, this embodiment is identical to the embodiment described with reference to Fig. 3, except for the fact that only one drive pin 414 is provided which cooperates with a drive channel 424. The axial linear motion is produced by having a drive channel 424 which is slightly inclined in the axial direction, thereby defining the axial stroke of the bristle carrier 420.

The only difference between the embodiment of a toothbrush 500 depicted in Fig. 5 and the previously described embodiments is that a sliding block 530 has a spherical shape. The sliding block 53 has a drive-pin bore 532 adapted to engage with an eccentric pin 52 of a drive shaft 50.

The sliding block is guided for axial displacement in an axial guide channel 528 of a bristle carrier 520. The bristle carrier 520 has a bearing bore 526 which guides the bristle carrier 520 on a bearing journal 516 for longitudinal displacement. The bearing journal 516 is attached to a toothbrush head 512 of a toothbrush body 510.

A drive pin 514 is disposed on the toothbrush head 512, wherein the drive pin 514 cooperates with a corresponding drive channel 524 in such a way that a pivoting motion of the bristle body 520 causes a positively-coupled axial stroke of the bristle body 520.

The embodiment of the toothbrush 600 illustrated in Fig. 6 is essentially identical to the embodiments depicted in Figs. 4 and 5.

Again, a toothbrush body 610 with a toothbrush head 612 is illustrated, wherein the toothbrush head 612 has a bearing journal 616. The bristle carrier 620 is supported for longitudinal displacement on the bearing journal 616 via a bearing bore 626.

As shown in detail in Figs. 4 and 5, a drive pin 614 cooperates with a drive channel 624 which is slightly inclined in the axial direction. This produces the axial stroke of the bristle carrier 620.

So far, the basic construction of the illustrated embodiment of the toothbrush is identical to that described with reference to the embodiments of Figs. 4 and 5, except for the fact that in the embodiment of a toothbrush 600 depicted in Fig. 6 the guide channel 628 is formed directly in the bristle carrier 620.

The eccentric pin 52 which can be set in rotation by the drive shaft 50 which is in turn driven by a motor, engages directly with the guide channel 628. The motor drive operating on the drive shaft 50 causes the eccentric pin 52 to move freely backward and forward in the guide channel 628 between a front and a rear reversing point. The eccentric pin 52 transmits a force to the bristle carrier 620 via the sides of the guide channel 628 which extend in the axial direction. To eliminate bending stress in the eccentric pin 52 which engages in the guide channel 628, the guide channel 628 has a cavity 634 extending inwardly in the radial direction, with the cavity 634 receiving the free end of the eccentric pin 52, with a space being formed between the free end and the inner wall of the cavity 634.

List of reference numerals

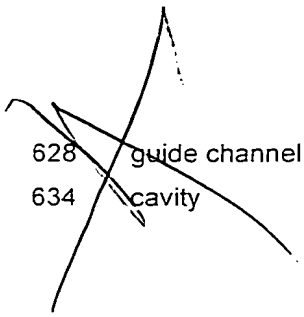
1	toothbrush
10	toothbrush body
12	toothbrush head
14	bearing channel
16	bearing journal
20	bristle carrier
24	bearing projection
26	bearing bore
28	recess
30	sliding block
32	guide channel
40	motor
50	drive shaft
52	eccentric pin
60	handle
200	toothbrush
210	toothbrush body
212	toothbrush head
214	bearing channel
216	bearing journal
220	bristle carrier
224	bearing projection
226	bearing bore
228	guide channel
230	sliding block
232	drive-pin bore
300	toothbrush
310	toothbrush body
312	toothbrush head
314	drive pin
316	bearing journal
320	bristle carrier
324	drive-pin channel

326 bearing bore
328 guide channel
330 sliding block
332 drive-pin bore

400 toothbrush
410 toothbrush body
412 toothbrush head
414 drive pin
416 bearing journal
420 bristle carrier
424 drive-pin channel
426 bearing bore
428 guide channel
430 sliding block
432 drive-pin bore

500 toothbrush
510 toothbrush body
512 toothbrush head
514 drive pin
516 bearing journal
520 bristle carrier
524 drive-pin channel
526 bearing bore
528 guide channel
530 sliding block
532 drive-pin bore

600 toothbrush
610 toothbrush body
612 toothbrush head
614 drive pin
616 bearing journal
620 bristle carrier
624 drive-pin channel
626 bearing bore


628
guide channel
634
cavity